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Short-Term Outcomes of Laparoscopic Roux-En-Y Reconstruction after Gastrectomy for Gastric Cancer: A Prospective Observational Study

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Abstract **Background:** Laparoscopic gastrectomy with Roux-en-Y reconstruction is a widely accepted procedure for gastric cancer. However, evidence on its short-term outcomes in the Indian population remains limited. **Methods:** This prospective observational study was conducted in the Department of General Surgery, Government Medical College, Srinagar, over 18 months. Patients with operable gastric carcinoma undergoing laparoscopic gastrectomy with Roux-en-Y reconstruction were assessed for intraoperative parameters, complications, lymph node yield and short-term postoperative outcomes. **Results:** Thirty-one patients were included (mean age 63 years; M:F = 3:1). Total gastrectomy and D2 lymphadenectomy were performed in most patients. The antecolic approach had a shorter operative time than the retrocolic approach ($p<0.001$). The mean blood loss was minimal and the overall complication rate was 16.1%, with no perioperative mortality. The mean hospital stay was 6-7 days and no cases of Roux limb stasis were observed. **Conclusion:** Laparoscopic Roux-en-Y reconstruction after gastrectomy is safe, feasible and associated with minimal morbidity and satisfactory short-term oncological outcomes.

Key Words Laparoscopic Gastrectomy, Roux-en-Y Reconstruction, Gastric Cancer, Short-Term Outcomes, D2 Lymphadenectomy

INTRODUCTION

It is the 5th most common cancer in the world which accounts for 4.8% of total cancer population worldwide. It is the 5th leading cause of Cancer Death in the world [1]. It is the 7th most common cancer in India [2]. Predominantly affects Men. It is the most common cancer in Jammu and Kashmir [3] along with CA Esophagus. Overall survival improves significantly with curative R0 resection.

While worldwide the standard technique is via a laparotomy, minimally invasive techniques, including endoscopic resection for very early tumors and laparoscopy, have proven effective. First Laparoscopic Gastrectomy with Billroth II reconstruction for Gastric Ulcer was carried out by Goh *et al* [4] in 1992. Laparoscopic Distal Gastrectomy for early Gastric cancer was first developed in Japan and was first reported by Kitano *et al.* [5] in 1994. After this preliminary result, the technique has spread in Asia with several case series confirming its safety and feasibility. Laparoscopic approach has been extended to include even Locally advanced Gastric cancers. Laparoscopic Gastric resections have advantages like any other Laparoscopic procedure like reduced pain, shorter hospitalization and improved Quality of Life. Long term Outcomes are comparable to Conventional Open Gastrectomies.

The extent of Lymphadenectomy associated with Gastrectomies have been controversial. Most patients with carcinoma stomach presents with Nodal metastasis at the time of Presentation. In these patients Lymphadenectomy improves the Staging accuracy and is the Standard of care. Current NCCN guidelines recommend D2 Lymphadenectomy in the "hands of experienced surgeons with expertise in the field, at tertiary centers where Gastrectomies are often performed." The Choice of Specific Reconstruction method remains unclear. Surgeons must understand the merits and demerits of every anastomotic device and procedure. A reasonable reconstruction procedure should be selected to improve the quality of Life Post Operatively by considering the following factors:

Safety (anastomosis with sufficient blood supply and free tension), Efficiency (Simple and Time Saving), Minimal Invasion (Less Blood Loss), Stability (surgeon's preference and experience) and Quality of Life (function preservation, if possible, reflux prevention and nutrition). The anastomosis of the gastric remnant to a defunctionalized jejunal limb in a RY reduces biliopancreatic reflux and abolishes the Afferent Loop Syndrome seen in Billroth-II.

RY reconstruction can reduce the incidence of food residues, Reflux Esophagitis, Remnant Gastritis and bile reflux in follow-up endoscopic findings and has a favourable long-term outcome than other techniques like Billroth-I and Billroth-II Reconstruction. Roux-en-Y reconstruction is a more complicated procedure than Billroth-I or Billroth-II because it involves two anastomoses [6]. Therefore, the operation time and anastomosis time were significantly longer for Roux-en-Y than for Billroth-1 and multiple anastomotic lines could increase the probability of anastomotic leakage.

RY reconstruction can be done Antecolic and Retrocolic. The choice between them depends on factors like Surgeon preference, patient anatomy and Risk of complications. Antecolic RY is technically easier, faster and carries Low risk of Internal Hernia and has disadvantages like delayed Gastric emptying. Retrocolic RY may improve gastric emptying but it is technically more complex, time consuming and there is higher risk of Internal Hernia because of the Mesocolic defect. Roux stasis syndrome [7] may occur in up to 30% of patients after Roux-en-Y gastroenterostomy and results from functional obstruction due to disruption of the normal propagation of pacesetter potentials in the Roux limb from the proximal duodenum as well as altered motility in the gastric remnant. Despite international evidence supporting laparoscopic gastrectomy with Roux-en-Y reconstruction, data from Indian centers remain scarce. Variations in patient profile, surgical expertise and resource availability warrant region-specific evaluation. This study was conducted to assess the short-term outcomes, safety and feasibility of laparoscopic Roux-en-Y reconstruction after gastrectomy in an Indian tertiary care setting.

Aim

The present study was aimed to Study the Safety and Feasibility of Laparoscopic Roux-en-Y Reconstruction after Laparoscopic Gastrectomy for Gastric Cancers.

Objectives

Primary Objectives

- **Intraoperative Complications:** To observe and record intraoperative complications encountered during the procedure, including stapler misfiring, injury to adjacent structures, bleeding and misjudgment of anatomical planes
- **Operative Time:** To measure the total operative time, defined as the interval from port placement to closure of skin incisions
- **Length of Hospital Stay:** To record the postoperative hospital stay, calculated from the day of surgery to the day of discharge

Secondary Objectives

- **Lymph Node Yield:** To determine the total number of lymph nodes retrieved from various stations, aiming for D2 lymphadenectomy
- **Oncological Outcome (up to 6 months):** To evaluate short-term oncological outcomes through follow-up at 2 weeks, 4 weeks, 3 months and 6 months using tumor markers, upper GI endoscopy and CECT abdomen/pelvis, focusing on local recurrence and disease-free survival
- **Roux Limb Stasis:** To monitor and document any occurrence of postoperative Roux limb stasis

MATERIALS AND METHODS

After obtaining approval from the Institutional Ethics Committee, the study was conducted in the Department of General Surgery, Government Medical College, Srinagar, over a period of 18 months, with patients followed up for 6 months postoperatively.

Ethical Approval

The study was approved by the Institutional Ethics Committee (Ref. No. GMC/IEC/2022/74) and written informed consent was obtained from all participants prior to inclusion in the study.

Study Design

Prospective observational study.

Study Design and Sampling

This was a prospective observational study. All patients diagnosed with operable gastric carcinoma and fulfilling the inclusion criteria during the study period were consecutively enrolled. A convenience sampling approach was used, as all eligible patients undergoing laparoscopic gastrectomy with Roux-en-Y reconstruction at the institution were included.

Sample Size Justification

A total of 31 patients were included in the study. The sample size was determined by the number of eligible cases presenting during the 18-month study period, considering the low incidence of operable gastric cancer and institutional case load. Although not based on a formal power calculation, this sample was deemed adequate for preliminary evaluation of short-term outcomes and feasibility in the regional population.

Statistical Analysis

Data were entered and analyzed using IBM SPSS Statistics, version 25.0 (IBM Corp., Armonk, NY, USA). Data normality was assessed using the Shapiro-Wilk test. Continuous variables were expressed as Mean±Standard deviation (SD), while categorical variables were presented as frequencies and percentages. The Mann-Whitney U test

was used for comparison between groups, with a p-value <0.05 considered statistically significant. The Mann-Whitney U test was used for comparison between groups, with a p-value <0.05 considered statistically significant. Follow-up data were analyzed descriptively, focusing on clinical outcomes and disease-free survival at 6 months.

Inclusion Criteria

- All Operable cases of CA-STOMACH
- With or Without Chemotherapy
- Patients Giving Consent

Exclusion Criteria

- GastroEsophageal Junction Tumours
- Metastatic Disease
- Unresectable Tumours
- Open Laparotomy Cases for Gastric Cancers

All the patients who met inclusion criteria were enrolled for the study. After admission detailed history and clinical examination were done in all the patients. Patient's data including Gender, Age, Clinical Presentation, Tumour location and histopathological type and grade of tumour were noted. All the Data obtained were recorded in the proforma and were subjected to relevant statistical analysis.

Surgical Procedure

All patients were preoperatively optimized with correction of electrolyte imbalances and nutritional deficiencies. Standard preoperative preparation included overnight fasting, Ryle's tube insertion with gastric lavage and bowel preparation using a polyethylene glycol-based solution 24-48 hours prior to surgery. A single prophylactic dose of intravenous antibiotic was administered one hour before induction of anesthesia.

The procedure was standardized for all patients undergoing laparoscopic Roux-en-Y reconstruction following laparoscopic gastrectomy. Under general anesthesia, patients were placed in the French position and pneumoperitoneum was established using a closed Veress needle technique. Port placement followed a uniform pattern to facilitate optimal exposure and ergonomics for the operating and assisting surgeons. A diagnostic laparoscopy was performed in all cases to rule out metastasis and confirm resectability.

Depending on tumor location, either total or distal laparoscopic gastrectomy was performed, followed by D2 lymphadenectomy as per oncological principles. Reconstruction was carried out using the Roux-en-Y technique, through either an antecolic or retrocolic route based on intraoperative assessment and surgeon preference.

Steps

The Procedure was Standardized for all the patients Undergoing Laparoscopic Roux-en-Y Reconstruction after Laparoscopic gastrectomy.

Port Placement

The patient was placed in the French position, with arms tucked by the side of the patient. The monitor was placed on the Left shoulder of the patient. General anaesthesia was administered and few of them were given epidural anaesthesia. The operating surgeon comes in between the legs of the patient and the camera surgeon would shift from right to left side as per the convenience of dissection by the operating surgeon. The assistant holding the liver would come from the right side. The scrub nurse would come from the right side of the surgeon. The pneumo-peritoneum was created with a closed technique using a Veress needle at the base of the umbilicus. The 10 mm optical port was placed through the umbilicus for distal gastric tumours and 2-3 cm above and to the left of umbilicus for tumours located in the incisura and body of stomach.

The two working ports were placed, one in the right upper quadrant 10/ 12 mm and other working port was placed in the left upper quadrant 10/12 mm. A 5 mm retraction port was made in the epigastric region and another accessory port was made below the right working port of the surgeon (5 mm), slightly head up position was given to the patient. Diagnostic laparoscopy was done as a standard protocol in all patients to stage the tumour (liver or peritoneal metastasis, ascites) and plan the surgical management. The status of the tumour, the site of tumour and its fixity to the underlying structures were confirmed. For the tumours placed distally in the antrum, pylorus and incisura, partial gastrectomy was performed. Tumours in the body or higher a total laparoscopic gastrectomy was performed.

The following steps of gastrectomy were performed in a step wise manner:

- Division of Gastrocolic Ligament and Short Gastric vessels
- Division of Gastro-colic, Duodeno-colic ligaments and Omentum
- Hepatoduodenal Clearance
- Division pf Hepatogastric Ligament
- Division of Left Gastric Vein and Artery
- Lymphadenectomy
- Duodenal dissection and Gastric/Esophageal resection
- Reconstruction

Roux-en-Y Reconstruction

The Steps involving Roux-en-Y Reconstruction are:

- Biliopancreatic Limb & Roux Limb Creation
- Gastrojejunostomy/ Esophago-jejunostomy
- Jejunojejunostomy

The cut end of the esophagus which is stapled by the linear stapler held by one/two stay sutures and fixed to the crura and to be anastomosed to the Roux loop in a side-to-side fashion. We identify the ligament of Treitz and follow the bowel 25-30 cm from ligament of Treitz, the bowel is cut by a linear stapler into proximal Biliopancreatic limb and distal Roux limb. The mesentery is cut so that loop of the jejunal bowel

selected will be freely mobile and able to reach the site of future gastro/esophageal-jejunal anastomosis. The anastomosis between gastric/esophagus and jejunum is performed by linear stapler. The Ryles tube is pushed by the anaesthetists and negotiated from the esophagus in to the Roux limb; the otomy is repaired by 2-0, 15 cm V loc. 35-40 cm down to this gastric/esophago-jejunal anastomosis, Jejuno-jejunostomy is performed in a side-to-side pattern by using linear stapler and otomy is closed by 2-0 15 cm V-Loc (Figure 1-6).

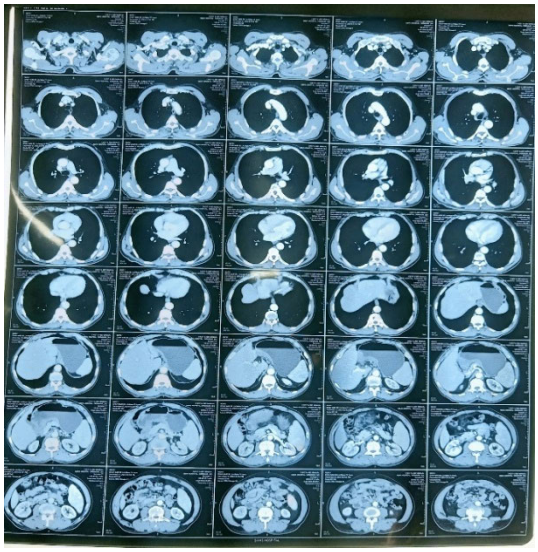

Figure 1: CECT Showing Circumferential enhancing Growth involving Antropyloric Region with extension along Lesser Curvature of Stomach. (Axial Plane)

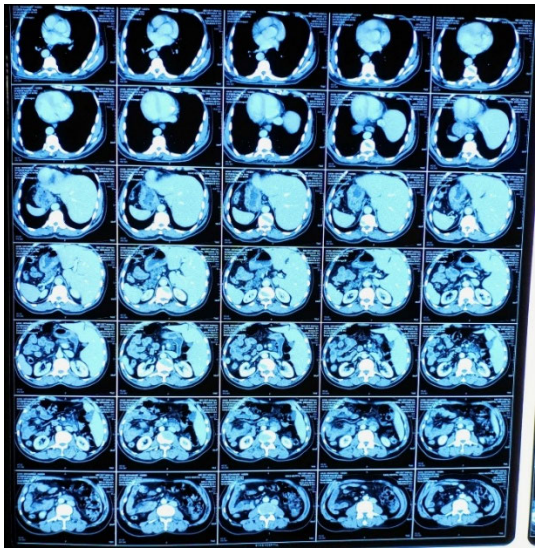

Figure 2: CECT Showing Hypo enhancing Thickening involving Mid Body of Stomach with Situs Inversus Totalis. (Axial Plane)

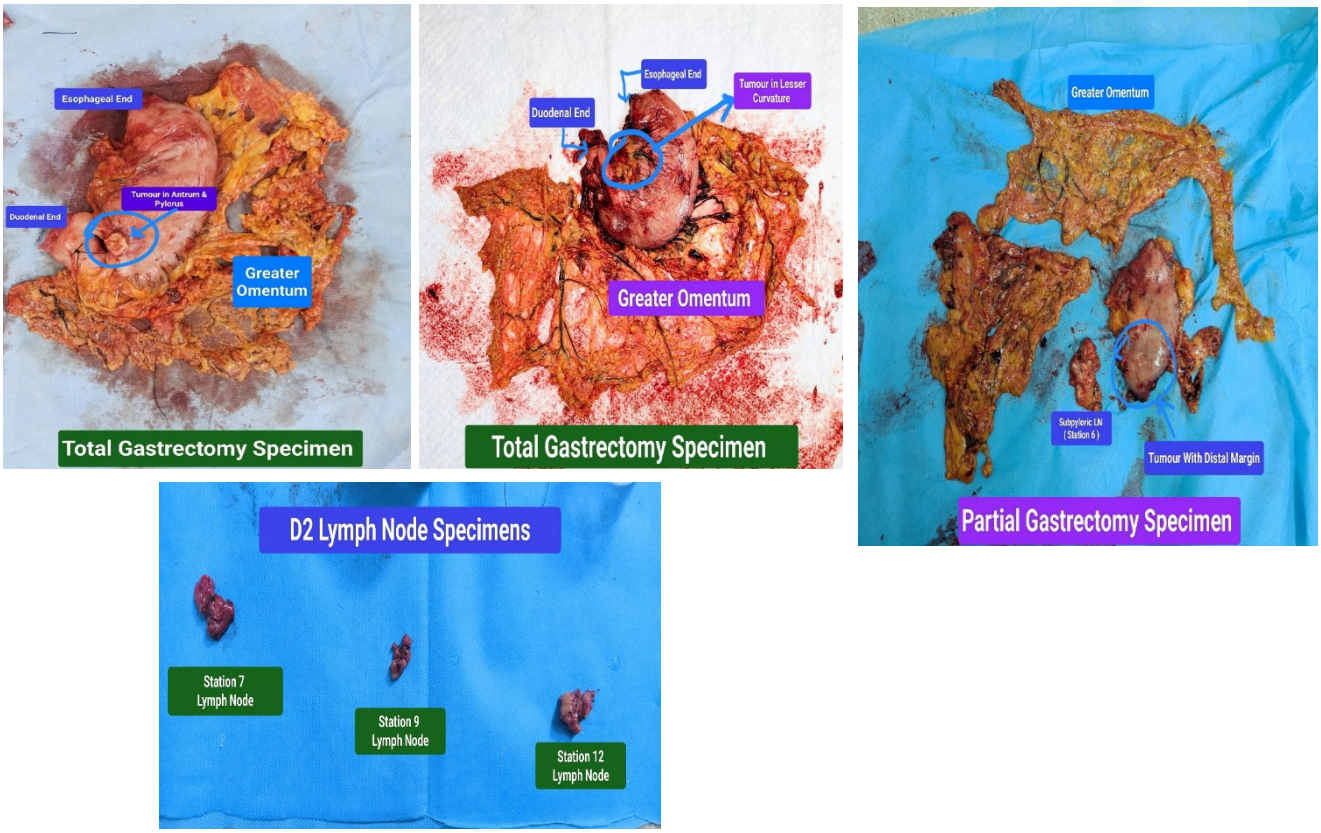

Figure 3: Operative Images of Total Gastrectomy with Ante-Colic Roux-En-Y Reconstruction in a Patient with Situs Inversus Totalis

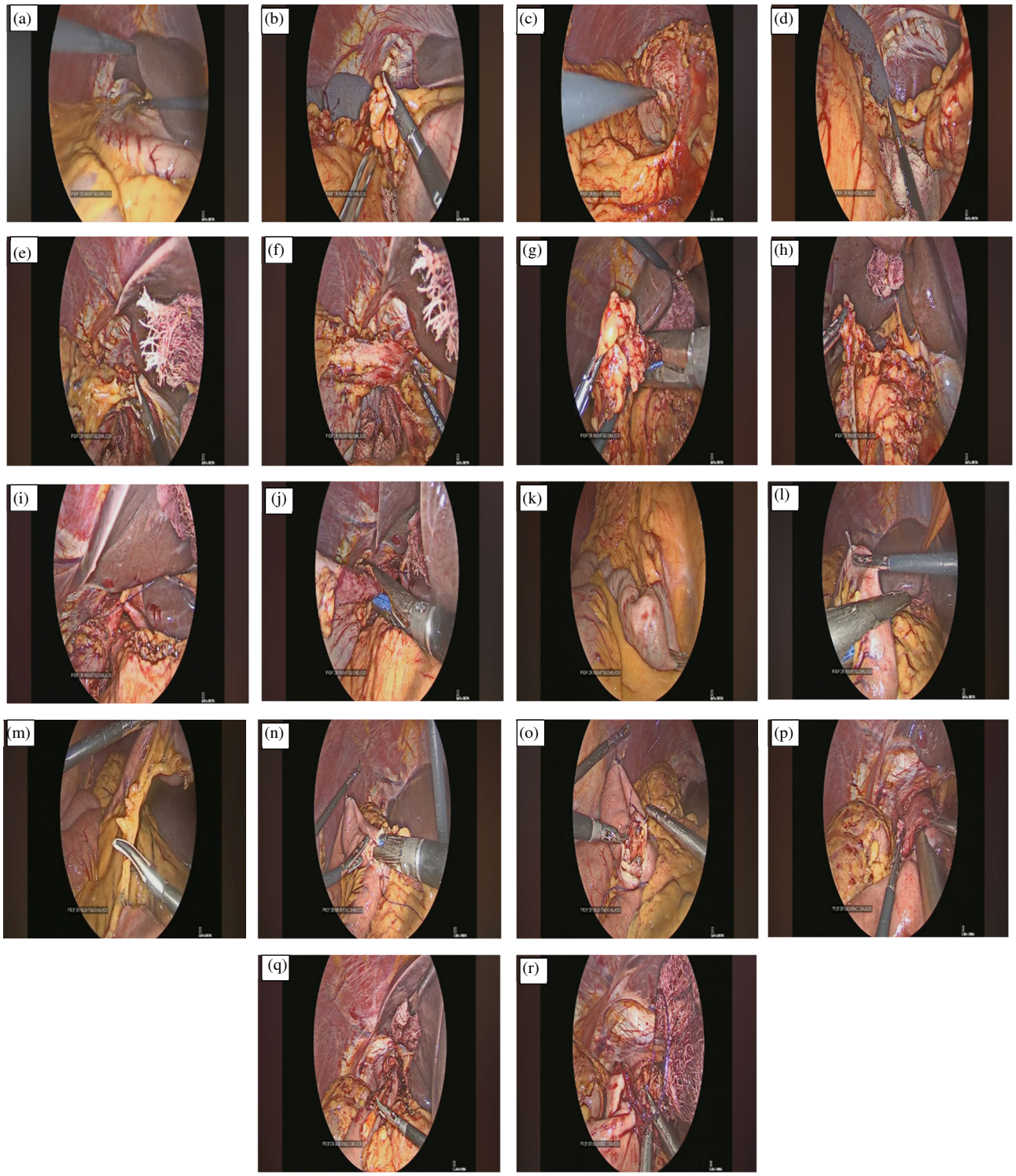

Figure 4(a-r): (a) Diagnostic Laparoscopy, (b) Division of Gastrocolic Ligament and Omentum, (c) Tumour in Mid Body (posterior wall), (d) Division of Short Gastrics and Gastrophrenic Ligaments, (e) Division of Lesser Omentum, (f) Mobilisation of Distal Esophagus, (g) Resection at D1 using Endo Linear Stapler, (h) Image Showing Duodenal Stump and Pancreas after Distal Resection of Stomach, (i) Stay Sutures at Crura of Diaphragm to prevent Retraction of Distal Esophagus into Thorax, (j) Resection at Distal Esophagus using Endo Linear Stapler, (k) Image showing DJ Flexure to begin tracing of Jejunum, (l) Resection of Jejunum 25-30 cm from DJ Flexure with Tattooing of Proximal (Biliopancreatic) Limb using Endoclips, (m) Division of Mesentery of Distal (Roux) Limb for Adequate Mobilisation, (n) Performing Jejunojejunostomy approx. 25-35 cm distal to Roux Limb, (o) Closing Otomy of Jejunojejunostomy using V-Loc Suture, (p) Performing Esophago-Jejunostomy, (q) Introducing Ryles Tube across Esophago-Jejunostomy and (r) Closing Otomy of Esophago-Jejunostomy using V-Loc Sutures

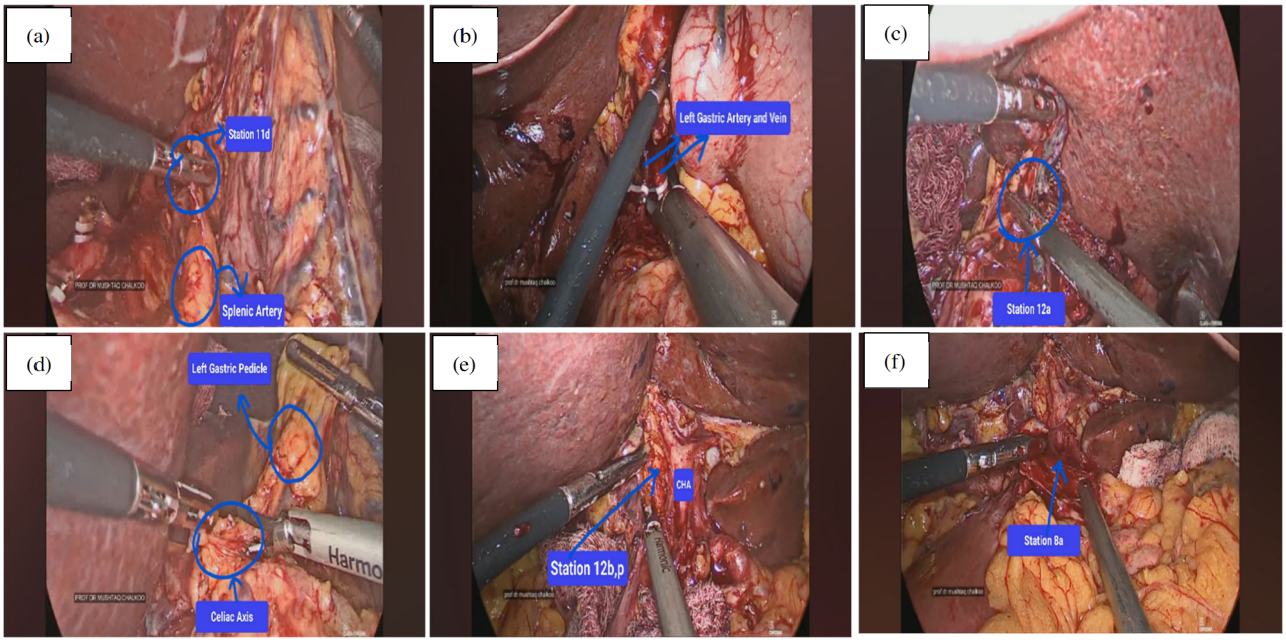

Figure 5(a-f): Images Showing D2 Lymphadenectomy, (a) Clearance of Station 11d- Distal Splenic Artery, (b) Clearance of Station 7 by Ligation of Left Gastric Artery and Vein, (c) Clearance of Station 12a-Left Hepatoduodenal, (d) Clearance of Station 9-Celiac Axis, (e) Clearance of Station 12b, p-Posterior Hepatoduodenal (CHA-Common Hepatic Artery) and (f) Clearance of Station 8a-Anterior Common Hepatic Artery

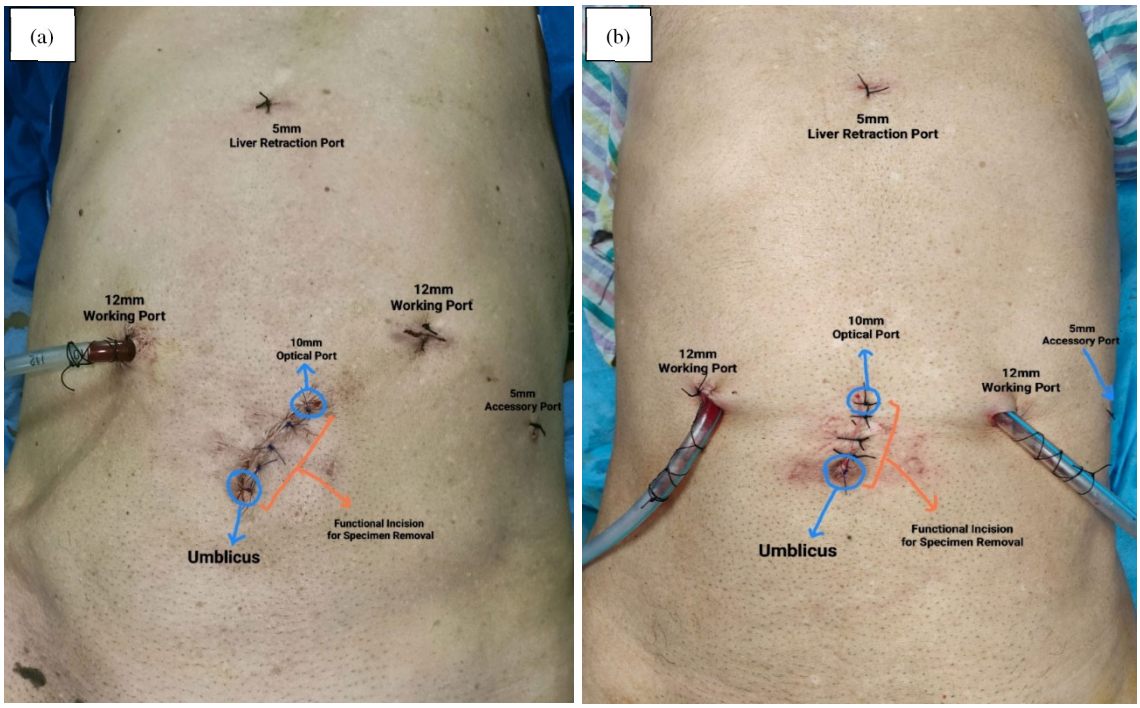

Figure 6(a-b): Images Showing Port Positions-Post OP, (a) Port Positions-Total Gastrectomy and (b) Port Positions-Partial Gastrectomy

RESULTS

A total of 31 patients were included in the study, with a mean age of 63 years and a male-to-female ratio of 3:1. Most patients underwent total gastrectomy with D2 lymphadenectomy and the antecolic Roux-en-Y route was used in the majority of cases. The overall operative outcomes were satisfactory, with minimal blood loss, acceptable operative duration and no perioperative mortality.

Operative and Postoperative Outcomes

The mean operative time was significantly shorter in the antecolic group compared to the retrocolic group ($p<0.001$).

The average blood loss ranged from 100-150 mL and the mean hospital stay was 6-7 days. The overall complication rate was 16.1%, with no major anastomotic leaks or Roux limb stasis reported.

Oncological and Functional Outcomes

Adequate lymph node retrieval was achieved in all cases, consistent with D2 lymphadenectomy standards. No cases of Roux stasis syndrome or local recurrence were observed within the 6-month follow-up period (Table 1-9).

Table 1: Summary of Operative and Short-Term Outcomes

Parameter	Antecolic (n = 25)	Retrocolic (n = 6)	p-value
Mean operative time (min)	195±5.3	213±9.3	<0.001
Mean blood loss (ml)	120±25	130±20	0.32
Complication rate (%)	16.1	-	-
Mean hospital stay (days)	6.5±1.2	7.0±1.0	0.28
Lymph node yield (mean±SD)	28±6	30±5	0.21
Roux limb stasis	None	None	-

Table 2: Biopsy Grade Distribution

Biopsy Grade	Frequency (N)	Percentage (%)
Grade I	7	22.58%
Grade II	10	32.26%
Grade III	12	38.71%
Inconclusive	2	6.45%
Total	31	100.00

Table 3: Type of Surgery Performed

Surgery Type	Frequency (N)	Percentage (%)
Total gastrectomy	30	96.77
Partial gastrectomy	1	3.23
Total	31	100.00

Table 4: Lymph Node Dissection Distribution

Type	Frequency (N)	Percentage (%)
D2 Lymphadenectomy	28	90.32
D1 Lymphadenectomy	3	9.68
Total	31	100.00

Table 5: Reconstruction Type Distribution

Reconstruction Type	Frequency (N)	Percentage (%)
Antecolic	25	80.65
Retrocolic	6	19.35
Total	31	100.00

Table 6: Roux Limb Length Distribution

Roux Limb Length			
Minimum (cm)	Maximum (cm)	Range	Median
30	40	30-40 cm	35 cm

Table 7: Distribution of Patients based on Roux-Limb Stasis

Number of Patients	Roux-Limb Stasis
31	0

Overall, the intraoperative complication rate was 6.45%, while postoperative complications occurred in 9.67% of patients, yielding an overall complication rate of 16.1%. Most complications were minor and managed conservatively, with no perioperative mortality. The low incidence of major adverse events reflects the safety and feasibility of laparoscopic Roux-en-Y reconstruction when performed by experienced surgeons. These results also indicate that the procedure offers acceptable morbidity and favorable short-term recovery, supporting its wider adoption in centers with adequate laparoscopic expertise (Table 8-17).

DISCUSSION

The present study demonstrates that laparoscopic Roux-en-Y reconstruction following gastrectomy is a safe and feasible approach, associated with minimal morbidity, acceptable operative duration and satisfactory short-term oncological outcomes. These findings reinforce the growing global evidence supporting the use of minimally invasive techniques in gastric cancer surgery.

Several long-term trials from Japan, Korea and China have compared laparoscopic versus open gastrectomy for both early and locally advanced gastric cancers, consistently showing comparable oncological efficacy with the added benefits of reduced blood loss, faster recovery and shorter hospital stay. The Japanese JCOG0912 trial, for instance, reported that laparoscopy-assisted distal gastrectomy was as safe as open distal gastrectomy in terms of adverse events and short-term clinical outcomes, establishing a benchmark for the laparoscopic approach in early gastric cancer.

Various Long-term Trails have been conducted in Japan, Korea and China comparing the Laparoscopic and Open Gastrectomies for Early and Locally advanced Gastric cancers and the results published were in favour of Laparoscopic approach for Gastric cancers in terms of both Feasibility and Oncological efficacy. The Japanese JCOG0912 [8]. Trail conducted study on the Short-term surgical outcomes of laparoscopy-assisted versus open distal gastrectomy with nodal dissection for clinical stage IA/IB gastric cancer (Early Gastric Cancers). This trail confirmed that Laparoscopy-Assisted Distal gastrectomy was as safe as Open Distal gastrectomy in terms of adverse events and short-term clinical and oncological outcomes.

The Korean KLASS-02 [9] RCT conducted study on the Long-Term Outcomes of Laparoscopic Distal gastrectomy for Locally Advanced Gastric Cancer and compared their results to Open Gastrectomies. This trail demonstrated that the 3 year relapse-free survival after laparoscopic distal

Table 8: Distribution of Operative Time

Type of gastrectomy	R-Y Type	Number of Patients (n)	Operative Time (in minutes)		p-value*
			Range	Mean (SD)	
Total gastrectomy	Antecolic	24	185-205	195 (5.28)	<0.001#
	Retrocolic	6	200-225	213 (9.35)	
Partial gastrectomy	Antecolic	1	165	165	
Total		31			

Abbreviation SD = Standard Deviation; *Mann-Whitney U test was used for comparison; # p<0.05 is significant

Table 9: Complications Distribution

Complication Type	Frequency (N)
Intra-operative complication	
• Division of Transverse Mesocolon	1
• Iatrogenic Pneumothorax	1
Immediate post-operative complication	
• Bleeding from Ryles Tube	1
Post- operative complication	
• Duodenal Stump Leak	1
After Discharge complication	
• Anastomotic Leak	1

The Intra Operative complication rate was 6.45%, Post operative complication rate was 9.67%, Overall complication rate was 16.12%

Table 10: Tumour Location Distribution

Tumour Location	Frequency (N)	Percentage (%)
Upper 1/3rd	15	48.39
Middle 1/3rd	13	41.94
Lower 1/3rd	3	9.68
Total	31	100.00

Table 11: Resection Status Distribution

Resection Status	Frequency (N)	Percentage (%)
R0	28	90.32
R1	3	9.67
R2	0	0
Total	31	100.00

Table 12: HPE Staging Distribution

Stage	Frequency (N)	Percentage (%)
1A	2	6.45
2B	3	9.68
3A	4	12.90
3B	7	22.58
3C	15	48.39
Total	31	100.00

Table 13: Lymph Node Yield Distribution

Parameter	Minimum	Maximum	Range
Lymph Nodes Identified	14	71	14-71
Lymph Nodes Involved	1	33	1-33

Table 14: Invasion distribution

Invasion	Present	Percentage (%)
Perineural Invasion	31	100
LymphoVascular Invasion	31	100

Table 15: WHO Histological Types

Histological Type	Frequency (N)	Percentage (%)
Papillary	3	9.68
Tubular	4	12.90
Mucinous	4	12.90
Mixed	6	19.35
Signet Ring Cell	4	12.90
Poorly Cohesive	10	32.26
Total	31	100%

Table 16: Follow-up Data Distribution

Status	Frequency (n)	Percentage (%)
Mortality	2	6.45
Did Well(DFS)	29	93.55
Total	31	100.00

Table 17: Adjuvant Therapy Distribution

Therapy type	Frequency (n)	Percentage (%)
Adjuvant Chemotherapy received	26	83.87%
Adjuvant Chemoradiation Advised	3	9.68%
Observation	2	6.45%
Total	31	100%

gastrectomy with D2 lymphadenectomy for locally advanced gastric cancer is comparable to that of open surgery. Further Laparoscopic surgery was associated with a lower incidence of early and late postoperative complications and better postoperative recovery than open surgery. The trail concluded that Laparoscopic distal gastrectomy with D2 lymphadenectomy could be a potential standard treatment option for locally advanced gastric cancer.

The Chinese CLASS-01 RCT [10], studied the Five-Year Outcomes of Laparoscopic vs Open Distal gastrectomy for Locally Advanced Gastric Cancer and found that laparoscopic distal gastrectomy with D2 lymphadenectomy resulted in similar 5-year overall survival compared with open distal gastrectomy among patients with locally advanced gastric cancer.

These various trails demonstrates that Laparoscopic approach for Gastric cancers could be a Standard Treatment as the results are very much comparable to Open technique both in terms of Feasibility and Clinical and Oncological outcomes in addition to the advantages associated with Laparoscopic surgery like Less Blood Loss, Shorter Hospital stay and faster recovery.

The choice of Reconstruction after gastrectomy is still being debated and several studies have recorded their findings in terms of Superiority of one over the Other. Although Data on Laparoscopic RY bypass as a bariatric procedure is widely available, Data on Laparoscopic RY Reconstruction for Gastric cancers after gastrectomy is Sparsely available in Indian Subset of Population. Having already published our work on laparoscopic gastric surgeries (laparoscopic D2 gastrectomy [11], laparoscopic hand-sewn gastrojejunostomy for gastric outlet obstruction [12]), In this study we aimed to evaluate safety and the feasibility of laparoscopic Roux-en-Y reconstruction following laparoscopic gastrectomy for gastric cancer (A Totally Laparoscopic Procedure). All patients who underwent Laparoscopic RY Reconstruction after gastrectomy for Gastric cancers were enrolled in our Study.

Patients who underwent open surgeries were excluded. In our study, a total of 31 patients were enrolled, operated by a single well experienced Laparoscopic surgeon over the period of 18 months. The most common age group in which gastric cancers were found are 61 - 70, 35.48% (n=11) followed by 51-60, 32.26% (n = 10). Lowest age group is seen in 31-40, 3.2% (n = 1) (Table 1). This observation was in accordance with the study conducted by Pradhan *et al.* [13] where mean age in males was 59±12.83 years, whereas the mean age of females was 54.01±13.41 years. The most common gender affected are Males, 74.1% (n = 23) followed by females, 25.8% (n = 8). Male to Female ratio is 3:1 (Table 1).

The most common age group found in males are 51-70, 65.1% (n = 15) followed by 71-80, 21.7% (n = 5). The most common age group found in females are also same 51-70, 75% (n = 5) followed by 71-80, 25% (n = 2). The lowest age group found in females is 31-40, 12.5% (n = 1). Overall, males were more commonly affected than females, except in the age group 51-70, where both genders are equally affected (Table 1).

All patients in our study had Biopsy proven disease except 2 patients whom were operated based on UGI Endoscopy and CECT findings. All patients had Adenocarcinoma. Majority of patients had Grade 3 (poorly differentiated) Adenocarcinoma, 38.7% (n=12) followed by Grade 2 (moderately differentiated), 32.2% (N = 10) and Grade 1 (well differentiated), 22.5% (n = 7). 2 patients had inconclusive Biopsy result, 6.45% (n = 2). This shows that majority of patients had Higher Histological Grade which represents the aggressive nature of the disease and worser prognosis (Table 2).

In our study, the most common procedure performed was Total gastrectomy, 96.77% (n = 30) as most patients had proximal and middle location of Tumours and extensions along Lesser / Greater Curvature of Stomach. Only one patient underwent Partial gastrectomy, 3.23% (n = 1). Distal gastrectomy was performed in None (n = 0) (Table 6).

Majority of patients underwent D2 Lymphadenectomy, 90.3% (n = 28) followed by D1 Lymphadenectomy, 9.68% (n = 3). D2 Lymph Node dissection is the standard of care and also improves Staging accuracy. Several studies have observed that D2 LN dissection is associated with improved Overall survival (Table 5).

In our study all the patients were offered Roux-en-Y Reconstruction following gastrectomy irrespective of type of gastrectomy performed as it is our primary objective. Majority of the patients underwent Antecolic RY, 80.6% (n = 25) followed by Retrocolic RY, 19.3% (n = 6). This shows that we preferred for Antecolic approach in most patients as it is technically easier and less Time consuming than Retrocolic approach (Table 5). This preference of Antecolic was based on the observations made by Ikeda *et al.* [14] who investigated the effect of different techniques on postoperative QOL.

None of the patients in our study had Roux Limb (Stasis) Syndrome (RLSS) (n = 0). Traditionally, RLSS was thought to occur more frequently following total gastrectomy, owing to the complete removal of the stomach and the resultant disruption of normal peristaltic coordination. This view was based on the belief that total gastrectomy results in extensive denervation of the Roux limb and loss of the natural gastric reservoir and pacemaker, thus impairing motility. Older studies and surgical texts emphasized that the absence of the stomach and the complexity of total gastrectomy increased the risk of stasis. As a result, subtotal (distal) gastrectomy with Billroth I reconstruction was often favoured to avoid this complication.

However, the Contemporary Literature differs in this Understanding of RLSS. More recent studies provided compelling evidence that RLSS is actually more common following distal or subtotal gastrectomy with Roux-en-Y reconstruction than after total gastrectomy. The key explanation lies in disrupted pacemaker coordination. In distal gastrectomy, the gastric remnant retains its pacemaker activity, which can interfere with the jejunal pacemaker of the Roux limb, leading to disordered motility patterns. Otsuka *et al.* [15] did a study to evaluate the frequency of Roux-en-Y syndrome in patients undergoing distal gastrectomy for gastric disease and said that Antecolic Reconstruction is associated with a significantly lower rate of RLSS. In contrast, factors such as sex, age, operative time and amount of blood loss were not found to be significantly related to RLSS and no significant statistical differences were identified with respect to other surgical factors.

Total gastrectomy removes the gastric pacemaker, allowing the jejunal pacemaker in the Roux limb to take over with more uniform and coordinated contractions. Current Clinical Consensus states that true Incidence of RLSS Varies from 5 to 30% depending on the type of gastrectomy and limb configuration and more common after distal/subtotal gastrectomy with Roux-en-Y than after total gastrectomy. Contributing Factors being Long Roux limb (>40 cm), Residual antral or gastric pacemaker activity, Incoordination between gastric and jejunal motility zones.

Various Management Strategies are, Conservative: dietary changes, prokinetics (e.g., metoclopramide, erythromycin). Surgical (if refractory): limb length revision, conversion to Billroth II or pouch interposition. The understanding of RLSS has evolved significantly. Contrary to earlier beliefs, current evidence supports that subtotal gastrectomy with Roux-en-Y is more commonly associated with RLSS than total gastrectomy, due to conflicting pacemaker activity between the gastric remnant and jejunum. Proper limb length and surgical technique play a crucial role in preventing this complication. Our study also supports the Current Literature as most patients underwent Total gastrectomy and none of the patients had RLSS. Moreover, the Roux Limb Length was standardised to 30-40 cm irrespective of the Type of gastrectomy done (Total gastrectomy -30, Partial gastrectomy-1). The Patients were also properly advised post operatively regarding the diet during initial few months like Small frequent meals preferably Liquids, avoid high sugar diet. These factors may explain why no patient developed Roux limb stasis syndrome (RLSS) in our study (Table 6, 7].

The Total Operative time for the entire procedure ranges from 165 minutes to 225 minutes with average time being 195 minutes. In our study, the operative time remained within the recorded ranges for all patients. Total gastrectomy with Antecolic Roux-en-Y was performed in 24 patients, with operative times ranging from 185 to 205 minutes (mean 195±5.28 minutes). In comparison, Total gastrectomy with Retrocolic Roux-en-Y was performed in 6 patients, with operative times ranging from 200 to 225 minutes (mean 213±9.35 minutes). Partial gastrectomy with Antecolic Roux-en-Y, performed in a single patient, required 165 minutes. This suggests that the Retrocolic approach is associated with longer operative times due to greater technical complexity, while partial gastrectomy remains less time-consuming than Total gastrectomy as it involves dissection to a Lesser extent (Table 8). According to the Literature, the median operative time was 150 min (range 130-180) in Partial astrectomy and 210 min (range 200-250) in Total gastrectomy. Our results of operative time were comparable for Partial gastrectomy and shorter for Total gastrectomy than that of the study conducted by Lee *et al.* [16] and colleagues in Korea, which reported a mean operative time of 227 min. This shows that mean operative

time in our study is shorter and reflects the experience gained over years in Laparoscopic Gastrectomies. All Stomach/ Esophagus/Jejunal transections were done using Linear Staplers with number of Stapler usage didn't differ much between the patients. The Stapler usage ranged from 5-7. All anastomoses were performed using Staplers and Otomies completed using 2-0 V-Loc (barbed thread) by Hand Sewn Technique. It is to be noted that Operative time was little higher in patients who underwent Retrocolic reconstruction compared to Antecolic reconstruction. No procedure was needed conversion to Open. Despite having to perform whole procedure Laparoscopically, Total time for the procedure stands comparable with the Standard Open technique.

We didn't experience any major intraoperative blood loss. Blood loss for the whole procedure ranges from 100-150 ml in all the patients.

Complications were seen in 5 patients with no patients experienced more than 1 complications. Intraoperative complications seen in 2 patients. In 1 patient there was misidentification. Transverse Mesocolon was misidentified as Gastrocolic Ligament/Greater Omentum which leads to compromised blood supply to Transverse Colon. We did Transverse colectomy with covering loop Ileostomy with Naso-jejunal feeding tube insertion following Gastrectomy. In 1 patient there was Iatrogenic Pneumothorax which happened while mobilisation of Distal Esophagus. It was managed by Intercostal chest tube drainage which was removed in the post operative period after adequate Lung Expansion. In the immediate post op period, 1 patient had Bleeding from Ryle's tube which was managed conservatively with Blood products. In the Post op period, 1 patient had Duodenal Stump Leak which happened on Post Op Day 4. Duodenal Stump Leak was found to be Low Output and managed conservatively. After discharge, 1 patient had delayed presentation of Anastomotic Leakage from Esophago-jejunostomy site who underwent Total Gastrectomy with Retro Colic Reconstruction which needed re-exploration and subsequent management with Endoscopic stenting and he recovered well. We analysed the possible causes for this Anastomotic Leak and we attributed this complication to Tension on the Anastomotic site and difficulty in mobilisation of distal esophagus. Although a wide variety of complications were seen at a different time period, all the complications have been managed well and no perioperative mortality was recorded. It is to be noted that no patients had more than 1 complication which is Statistically Significant (Table 9).

The average time for the appearance of Bowel sounds was found to be 3 days and for appreciation of First Flatus was found to be 3.5 days. Oral sips were started in POD 4-6 depending upon the bowel sounds. Most Patients were discharged by 7/8th POD. No patients had Hospital Stay of more than 8th POD except 1 patient who needed Readmission on POD 15 in view of Anastomotic Leak. Readmission rate was only 3.2% (n = 1).

In our study most patients had tumour in upper 1/3rd of Stomach, 48.39% (n = 15), followed by middle 1/3rd, 41.94% (n = 13). The Lower 1/3rd tumour location was the least in our study participants, 9.68% (n = 3), out of 3 distal tumours, 2 patients had locally advanced disease with extensions to body of stomach and they also underwent Total Gastrectomy, 1 patient had tumour limited to distal Stomach subsequently underwent Partial Gastrectomy as resection margins were achievable by Partial resection of stomach. (Table 13). Although shift from distal to Proximal location of tumours were not reported from India, our study shows that most patients had proximal locations. This observation needs further research with larger sample size for confirmation. However, in the study conducted by Mariya Amin Qurieshi *et al*. [17], Gastric cancers in Kashmir showed that patients had tumours in proximal and middle locations equally to distal tumours.

Majority of patients had R0 resection, 90.3% (n = 28) indicating complete resection of tumour with Negative proximal and distal margins followed by R1 resection, 9.67% (n = 3). In patients who had R1 resection, 1 patient had positive Proximal resection margin, 1 patient had positive distal resection margin and 1 patient had both resection margins positive (Table 14).

Majority of patients were in Stage 3C disease, 48.39% (n = 15) followed by Stage 3B, 22.58% (n = 7) followed by Stage 3A, 12.90% (n = 4). 3 patients had Stage 2B disease, 9.68% (n = 3) and 2 patients had Stage 1A disease, 6.45% (n = 2). This indicates that majority of patients were diagnosed at late stages with Nodal disease which reinstates the need for D2 Lymphadenectomy for better outcome on overall survival (Table 12).

The number of Lymph Nodes yielded from the Specimen ranges from 14-71 with Tumour involvement in the nodes ranged from 1-33. In our study, the rate of >15 retrieved Lymph node is 81.25%. Median Lymph node Yield was 28. Our observations with Lymph node Yield were well higher compared to the Cohort study conducted by Brenkman *et al*. [18] where the median lymph node retrieved was 20 (Table 11).

All the patients had Perineural and Lympho-vascular involvement, 100% (n = 31) (Table 17). On 6 months follow up of our patients, most of the patients were doing well in terms of Oncological Outcome (Disease Free Survival) and Quality of Life, 93.55% (n = 29). Mortality was seen in 2 patients, 6.45% (n = 2), one of the patients died at 3rd month and another patient died at 4th month due to Local recurrence. We observed that the procedure yielded better short-term results in terms of Oncological Outcome and Quality of Life in most patients (Table 17).

According to the NCCN Guidelines for Gastric cancers, Except for the patients with Stage 1A disease (n = 2), all the patients were referred to Medical Oncology for Adjuvant therapy and subsequently they have been advised for Adjuvant Chemoradiation, 9.68% (n = 3) for 3 patients who had R1 Resection. Out of 26 patients who had R0 resection, 25 patients underwent Primary D2 Lymphadenectomy and 1 patient had D1 Lymphadenectomy. So, all 26 patients were advised for Adjuvant Chemotherapy, 83.87% (n = 26). (Table 15).

In the context of developing countries, where access to advanced surgical facilities and postoperative oncology care may be limited, the findings of this study have important

practical implications. The demonstrated safety, low complication rate and oncological adequacy of laparoscopic Roux-en-Y reconstruction suggest that this minimally invasive approach can be effectively implemented in resource-limited tertiary centers with appropriate training and infrastructure. Adherence to standardized oncological principles-such as D2 lymphadenectomy and guideline-based adjuvant therapy as per NCCN recommendations-can ensure outcomes comparable to high-volume international centers. Wider adoption of laparoscopic techniques may also reduce hospital stay, lower infection rates and optimize resource utilization, thereby improving the overall quality of gastric cancer management in low- and middle-income settings. None of the patients experienced wound infection in our Study except 1 patient who underwent Re exploration.

CONCLUSIONS

Laparoscopic Roux-en-Y reconstruction after gastrectomy for gastric cancer is a safe, feasible and oncologically sound procedure with minimal morbidity and acceptable operative duration. The study demonstrated low complication rates, adequate lymph node yield and no perioperative mortality, confirming its suitability for routine surgical practice. With adherence to standardized oncological principles and NCCN-guided adjuvant therapy, outcomes comparable to high-volume international centers can be achieved. The procedure's favorable recovery profile makes it particularly advantageous in resource-limited settings. Wider adoption of laparoscopic techniques through structured training programs is recommended to enhance gastric cancer care in developing countries. Over the years, Minimal Invasive approach for Gastric cancers has been expanding from early Gastric Cancers to advanced Gastric cancers. With continued improvements in surgical Techniques, surgical equipment's and gaining experience, Laparoscopic Gastrointestinal reconstructions is no more a challenge for experienced Surgeons. Laparoscopic Roux-en-Y Reconstruction following Laparoscopic gastrectomy (Totally Laparoscopic Approach) is Safe and Feasible with minimal (potentially avoidable) complications even in Locally advanced Gastric Cancers in terms of Short-term Surgical and Oncological outcomes and has the advantages of minimal blood loss, faster recovery, shorter hospital stays and Better Quality of Life.

Limitations

This study has certain limitations. It was a single-center study with a small sample size, which may limit the generalizability of the findings. Additionally, the short follow-up duration allowed only short-term outcomes to be assessed, without evaluating long-term survival or recurrence. Future multicenter studies with larger cohorts and extended follow-up are recommended to validate and expand upon the observations reported here.

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